

Considerations for the development of a method for identification of signature components of World Trade Center contamination.

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for the World Trade Center Expert Technical Review Panel, Dr. Paul Gilman, Chair**

Background

The Panel has expressed a desire to investigate the development of a set of criteria and, if feasible, a validated analytical method for using signature components for identification of WTC contamination. At Dr. Gilman's request during the May 12 phone conference we are submitting a summary of suggestions pertaining to steps required to identify a set of measurable signature components and to produce a validated analytical method for detecting WTC contamination.

The desirability of such a method is driven by the following factors:

- 1) The Panel, in response to public input, feels that testing for contamination in addition to re-contamination of previously cleaned units is the proper course.
- 2) The testing should be conducted in a comprehensive program to include a full range of sampling units and/or structures to be later defined (sub-group on sampling units)
- 3) Testing for asbestos (or other identified COPC that may be present in indoor air) as a single trace surrogate will not uniquely identify WTC contamination.

WTC contamination can be divided into three components; 1) dust generated by the collapse of the buildings, which may have been dispersed by rescue and recovery activities, and by transportation of debris away from the WTC site; 2) materials and aerosols produced from combustion and incineration on September 11, and for several weeks afterward; and 3) particulate matter and aerosols generated by the heavy equipment used during recovery operations. These three components are likely to be mixed and it is possible that one or two of the components may be dominant in a given sample. In this initial discussion we will focus primarily on the dust generated by the collapse of the buildings. Detailed evaluation of contamination due to long-term incineration and heavy equipment usage during recovery operations will be addressed in more detail separately.

Most, if not all independent published studies agree that the WTC dust is composed of three major components: man made vitreous fibers (MMVF), concrete dust, and gypsum (1-5). All of these components are common construction materials. Of these three components the one most easily identifiable and measurable, and least likely to be a common background material is the MMVF. The MMVF present in the WTC dust are primarily slag wool (> 80 %) (1). Slag wool was present in the WTC as spray-on thermal insulation on the steel beams, under the floors, and probably in ceiling tiles. Slag wool includes fibers of different sizes and shapes, and spheres (shot). The composition of slag wool as defined by the glass fiber industry (6, 7) is specific and easily identified by x-ray microanalysis using either SEM or TEM. Slag wool is easily distinguished chemically from other types of MMVF such as

rock wool and soda-lime glass fibers (Figure 1). Given the predominance of slag wool versus other MMVF in the WTC dust it is extremely unlikely that a sample containing another type of MMVF without slag wool would have a WTC source.

Research also suggests that the major components discussed above will remain in approximately the same ratio even through size sorting and dissemination into buildings and structures through air intake systems, cracks around windows and doors, etc (5, 8).

Furthermore, many studies of indoor air, conducted in the U.S. and in Europe, have concluded that concentrations of MMVF in indoor air are extremely low under normal conditions (9-14, and references therein). These studies have been conducted in a variety of building types including residential, commercial, and schools.

Given these factors, it seems possible that a WTC dust signature could be identified by using slag wool fibers probably in combination with some of the other major, minor or trace components in the dust.

In addition to the major and minor signature materials, recent studies have demonstrated that organic and inorganic trace signatures may also provide a measurable signature for WTC contamination. Studies of organic components have revealed a distinct PAH signature in both indoor and outdoor bulk WTC dust samples (Figure 2) (15). Other studies have demonstrated possible characteristic trace element patterns in bulk dust and on size-fractionated samples (16, 17). These trace components could provide a powerful confirmation of the presence of WTC contamination. The applicability of these trace signatures will likely depend on the amount of sample collected from a given sampling unit and the amount of dilution that sample has experienced.

Concerns

- 1) All of the major and minor components of WTC dust are common construction materials. As such, it is possible that these components will be present in ambient indoor air at levels high enough to preclude their use as WTC signature materials. It may still be possible, however, to use trace indicators even if major and minor signature materials such as slag wool and concrete dust are not identifiable or are overwhelmed by similar materials from other sources.
- 2) It is almost certain that all buildings and structures in lower Manhattan will be different with respect to materials used, configuration of HVAC systems, condition of interior buildings components, and construction and renovation history. These factors may influence the applicability of any method using signature components for detection of WTC contamination.
- 3) The impacted area is also undergoing gentrification on a large scale. Tens of thousands of housing units have been created in what were formerly industrial and

commercial structures. The ongoing contamination from this process must be distinguished from the WTC materials.

Process of Evaluation of Proposed Signature Components

The process of evaluation should be conducted as rapidly as possible using existing resources wherever possible. The community should participate in the process. The process should proceed as follows:

- 1) EPA would immediately initiate a background study. The background study is necessary to insure that the proposed major and minor signature components are not common materials in typical background samples representing sampling units under consideration. This study should begin with reanalysis of previously obtained background samples from the WTC Background Study. Additional samples collected from a subset of newly defined sampling units as yet to be determined should also be collected and analyzed as resources become available. The background study should also include samples previously collected by other agencies such as OSHA, ATSDR, and the City of New York. The background study should include air samples, surface dust samples and samples from HVAC systems. The study should also consider published studies of indoor air contaminants.
- 2) Simultaneously with 1) above, samples taken from buildings and areas where WTC contamination is known to have been present should be reexamined for the major, minor, and trace components. The data from these samples would then be evaluated to determine if a statistically valid WTC signature is evident. If a WTC signature is evident, additional samples should be analyzed including air and surface dust to further define detection limits, general applicability with respect to various sampling units, and typical dust concentration levels. The initial analytical tools for this study would be SEM and TEM with x-ray microanalysis to determine accurate fiber chemistry. If SEM is used, overloaded filters may also provide useful information. SEM also has the advantage of being able to scan large surface areas of sample substrate rapidly. This would enable analyses to be conducted with much better sensitivity in a shorter amount of time than TEM analyses of the same samples.
- 3) In addition to analysis for MMVF and other major components the samples (or additional samples taken concurrently) should be analyzed for trace elements, probably by x-ray fluorescence (XRF), and for PAHs. These analyses will determine if trace components will aid in the detection of WTC dust and combustion products.
- 4) If the background study shows slag wool to be a common constituent of indoor air and dust, slag wool will probably not work as a signature component and the process should be shifted to concentrate on other possible signatures. In the event this method proves to be unusable at any point, the Panel should continue to consider alternative approaches of dealing with the issues of contamination and recontamination.

- 5) A survey of commercial, government and academic laboratories and researchers with knowledge of WTC dust should be conducted to determine what additional resources might already exist that could aid in the development of a WTC signature.
- 6) The above studies should be conducted in coordination with this subcommittee, the community, and other persons or entities as deemed appropriate by the Panel.

Finally, during the May 12 phone conference David Newman asked what steps should be taken if a WTC signature is identified and that signature is not detected in sampling units. We believe the answer to this question must wait until the initial testing is complete. The answer will likely depend on the analytical sensitivity that can be achieved for each signature component and the confidence we have in the assumption that the fine dust will not fractionate but will retain a relatively constant ratio of major and trace components.

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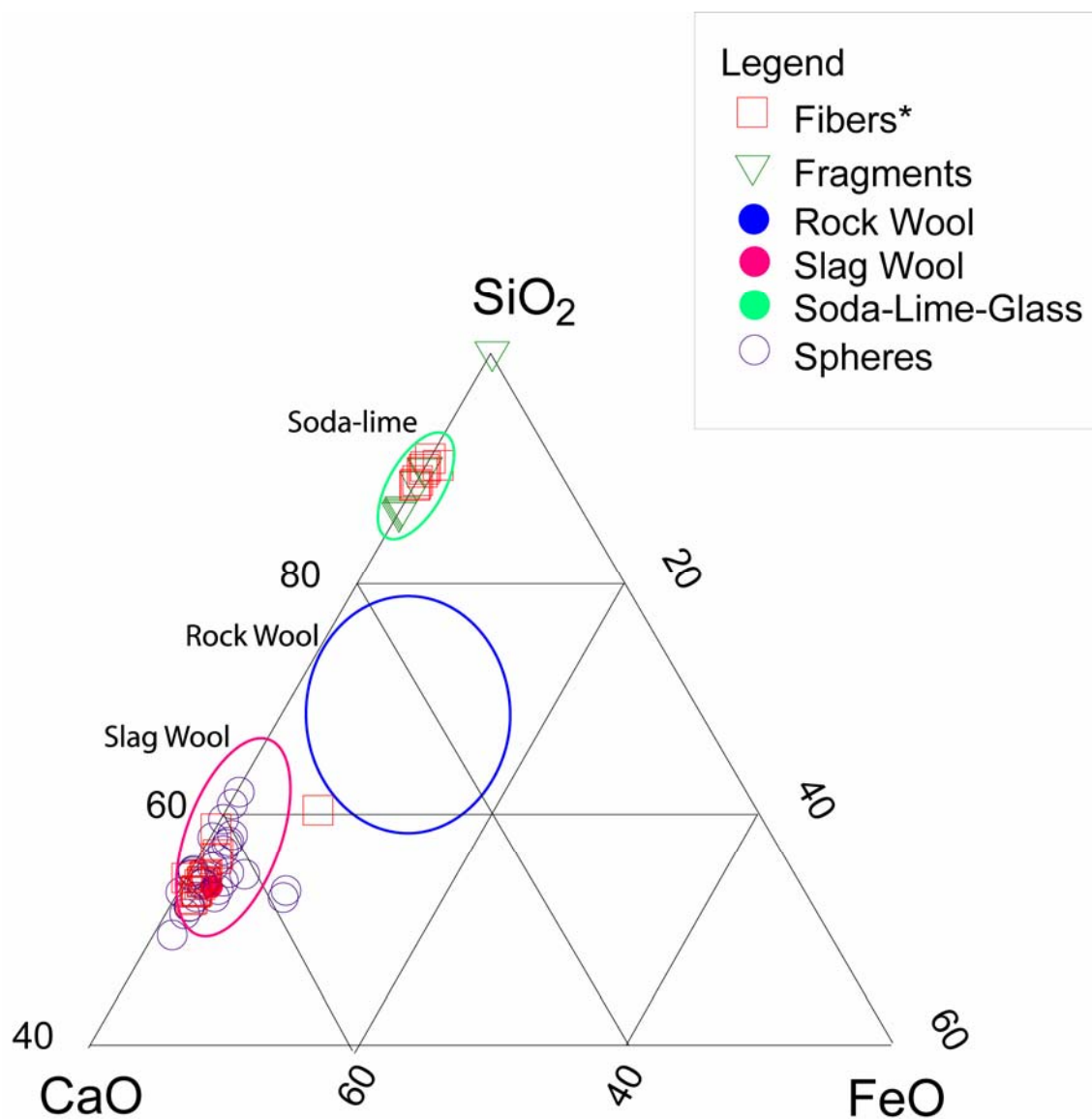


Figure 1. Relative compositions of SiO_2 , CaO , and FeO for MMVF, glass spheres, and glass fragments from WTC dust and debris. The fields for slag wool (red), rock wool (blue) and soda-lime glass (green) as defined by the glass industry (6, 7) are outlined. Note that the vast majority of fibers and spheres are of the same composition. Data taken from (1, 5). *Most of the fibers in the soda-lime glass field were obtained from large pieces of yellow thermal insulation found semi-intact in the debris and were not microscopic structures found in the dust.

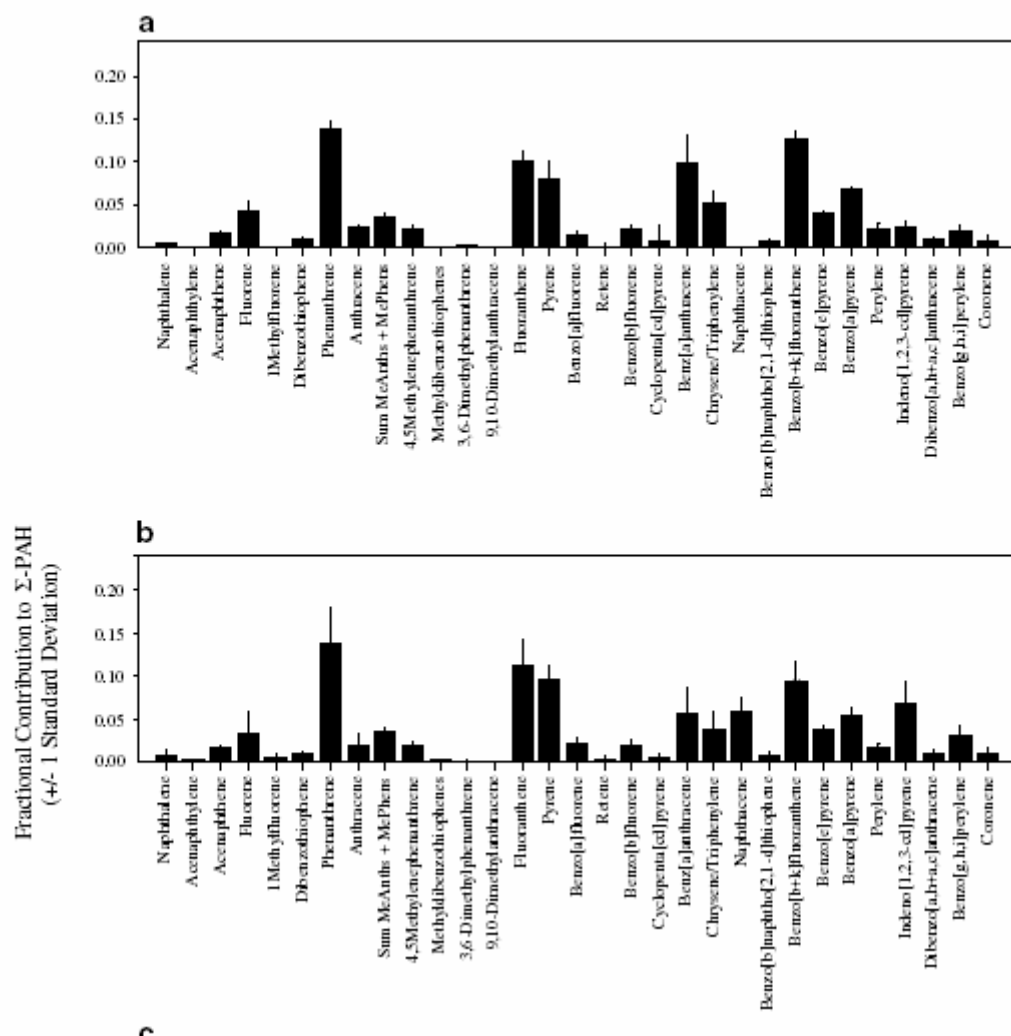


Figure 2. WTC PAH signature from indoor dust (top) and outdoor dust (bottom). From Offenber, et al. (15).